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10/567,124	02/06/2006	Miyuki Tsukioka	126928	2903

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EXAMINER	
CLARK, GREGORY D	
ART UNIT	PAPER NUMBER
1786	

NOTIFICATION DATE	DELIVERY MODE
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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Office Action Summary	Application No.	Applicant(s)	
	10/567,124	TSUKIOKA ET AL.	
	Examiner	Art Unit	
	GREGORY CLARK	1786	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *06 June 2011*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,2,5-7,10 and 13-15* is/are pending in the application.

4a) Of the above claim(s) *3,4,8,9,11 and 12* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,2,5-7,10 and 13* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

The examiner acknowledges the receipt of applicants' amendments and arguments dated 06/06/2011.

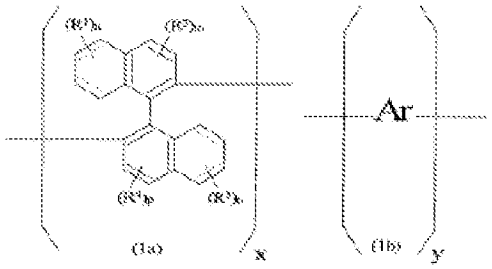
Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

1. **Claims 1-2, 6-7, 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Liu (Chemical Materials, Vol. 13, N0. 6, pages 1984-1991) in view of Chen (US 2004/0106003).**

2. **Regarding Claims 1-2**, applicant claims an electroluminescent polymer represented by Formula(s) 1a and 1b:



wherein:

R^1, R^2, R^3, and R^4 are each independently hydrogen, alkyl, alkenyl, alkynyl, aralkyl, aryl, heteroaryl, alkoxyl, aryloxy, or aliphatic heterocyclic group;

the double bonds of the binaphthyl structural unit indicated by dashed lines and solid lines are each an unsaturated double bond or a saturated single bond;

m and p are each independently 0, 1, or 2;

n and o are each independently 0, 1, 2, 3, 4, 5, 6, 7, or 8;

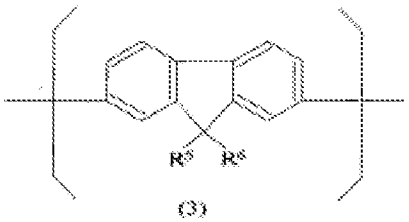
when m, n, o, or p is an integer of 2 or greater, the two or more R^1s, R^2s, R^3s, or R^4s may or may not be identical to one another;

x is in a range of from 5 to 50 mol%;

~~y is the molar fraction of the aryl structural units;~~

y is in a range of 50 to 95 mol%, and

Ar is an aryl structural unit that can form an electroluminescent π-conjugated polymer, the aryl structural unit being a fluorene derivative structural unit represented by formula (3):

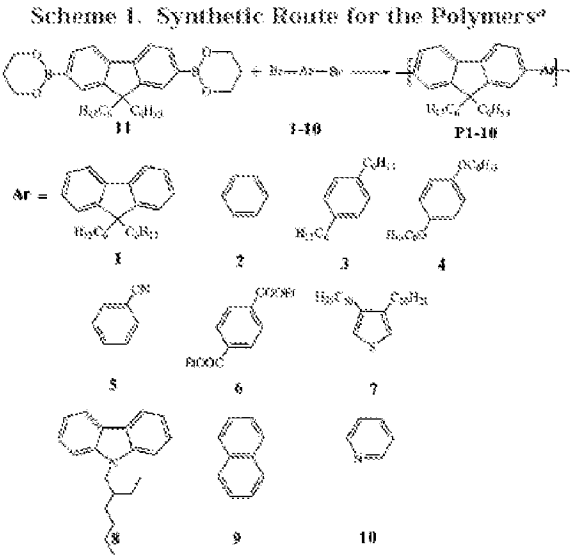


(3)

where R^5 and R^6 are each independently hydrogen, alkyl, alkenyl, alkynyl, aralkyl, aryl, heteroaryl, alkoxyl, aryloxy, or aliphatic heterocyclic group.

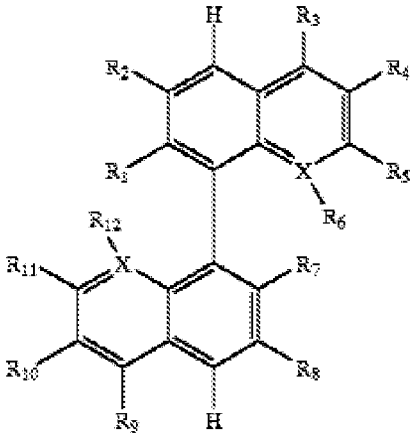
Liu discloses alternating polyfluorene copolymers with different main chain aromatic (phenylene) structures attached at the 2 and 5 positions synthesized by a

palladium-catalyzed Suzuki coupling reaction (abstract). Scheme 1 shows the synthetic rout to the polymers:

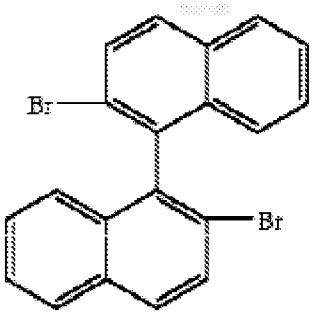


Liu further mentions that copolymerization of fluorene with various aryl partners allows for tunability of the electronic properties with enhanced stability (page 1985). Liu shows a number of reactive aromatic species (Br-Ar-Br) including napthyl species 10 but fails to mention the binapthylene species claimed by applicant.

Chen discloses a binapthylene derivative that is reactive by a palladium-catalyzed Suzuki coupling reaction (paragraph 30) which is used to make electroluminescent compounds (paragraph 30) represented by Formula C-1 (paragraph 21):



wherein X can be a carbon atom; R6 and R12 can be substituted by aromatic compounds (paragraph 22). R1-12 can be hydrogen, alkyl or aromatic (paragraph 11). Formula C-1 as a reactive species can be represented by Formula C-2 (paragraph 44):



Chen further mentions that an advantage for using a binaphthylene derivative in an organic electroluminescent device (OLED) is that close molecular packing is prevented due to the large dihedral angle between the two naphthyl groups. When close molecular packing is prevented, the resulting OLED shows high photo and electro-luminescent efficiency (paragraph 9).

Formula C-2 by Chen represents an aromatic dibromide species which is used in analogous manner to the reactive aromatic species Br-Ar-Br of Liu (above). The

aromatic species (Br-Ar-Br) of Liu and Formula C-2 of Chen are components used to make materials used in OLED. As Liu teaches that incorporating dinaphthyl derivatives prevents close molecular packing resulting OLED shows high photo and electro-luminescent efficiency, one could envisage replacing a Br-Ar-Br species from Liu with Formula C-2 of Chen to make a polymer with improved photo and electro-luminescent efficiency.

It would have been obvious to one of ordinary skill in the art at the time of the invention to have selected from known Suzuki reactive Br-Ar-Br species which would have included Formula C-2 of Liu which reads on the instant limitations since Liu teaches that incorporating dinaphthyl derivatives prevents close molecular packing resulting OLED shows high photo and electro-luminescent efficiency, absent unexpected results.

Lui and Chen fail to mention the molar fraction of the dinaphthyl derivative (x) and the fluorene derivative (y). Applicant claims 50-95 mol% and 50-95 mol%.

As Chen teaches that the dinaphthyl derivative prevents close molecular packing resulting in an OLED that shows high photo and electro-luminescent efficiency, the molar fractions of copolymers containing a dinaphthyl derivative (x) and a fluorene derivative (y) is viewed as a cause effective variable to optimize the photo and electro-luminescent efficiency. In cases where the dinaphthyl derivative (x) fraction was too low, the luminescent efficiency would be decreased.

It would have been obvious to one of ordinary skill in the art at the time of the invention to have adjusted the molar fraction of the dinaphthyl derivative (x) and the

fluorene derivative (y) to optimize the photo and electro-luminescent efficiency which would have included the claimed ranges, absent unexpected results.

3. **Regarding Claims 6-7, 10,** Liu in view of Chen teaches the invention of claims 1-2 (discussed above).

Chen discloses an electroluminescent device containing a luminescent layer composed of a dinaphtyl derivative between two electrodes (paragraph 10) (per claims 6 and 10). Chen discloses that electroluminescent device can be used in a display (paragraph 4) (per claim 7).

4. **Claims 5 and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Liu (Chemical Materials, Vol. 13, N0. 6, pages 1984-1991) in view of Chen (US 2004/0106003) as evidenced by Pielichowski (Progress in Polymer, 2003, Vol. 28, pages 1297-1353).**

5. **Regarding Claim 5,** Liu in view of Chen disclose the invention of claim 1. The copolymer composed of the dinaphthyl derivative (x) and the fluorene derivative (y). Formula C-1 (above) shows a dinaphthyl derivative where m is 2, p is 2, n is 3 and o is 3. Applicant claims that m, n, o or p is an integer of 2 or greater.

Liu discloses that the electronic properties of the conjugated polymer are primarily governed by the chemical structure of the backbone itself. One way to achieve high efficiency in a polymer electroluminescent device (PLED) is to develop materials

that have charge transporting properties (page 1985). Liu shows in Scheme 1(above) carbazole derivative 8 but fails to mention a terpolymer of identify carbazole derivative 8 as a charge transporting material.

Pielichowski discloses carbazole containing polymers as charge transporting materials (page 1298) used in an electroluminescent device (abstract).

As Liu mentions that the electronic properties of the conjugated polymer is primarily governed by the chemical structure of the backbone and shows a charge transporting carbazole derivative 8.

It would have been obvious to one of ordinary skill in the art at the time of the invention to have modified the electroluminescent copolymer of Liu in view of Chen by incorporating a third monomer which would have included the Suzuki carbazole 8 of Liu which read on the instant limitations since Liu teaches that higher efficiency in a polymer electroluminescent device (PLED) can be achieved with the copolymers which also have charge transporting properties.

6. **Regarding Claim 13,** Liu in view of Chen and Pielichowski teaches the invention of claim 5 (discussed above). Chen discloses an electroluminescent device containing a luminescent layer composed of a dinaphtyl derivative between two electrodes (paragraph 10).

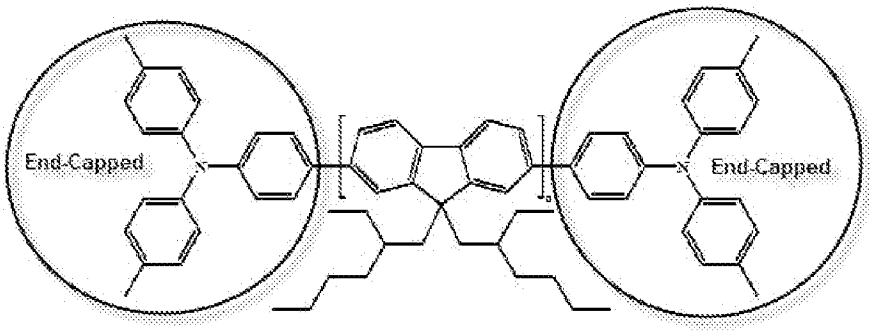
7. **Claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over Liu (Chemical Materials, Vol. 13, N0. 6, pages 1984-1991) in view of Chen (US 2004/0106003) and Yasuda (2002/0173617).**

8. **Regarding Claim 14**, Lui and Chen teach the invention of claim1. Lui mentions a molecular weight range of roughly ~20,300 to 118, 400 (Table 1, page 1887). Lui fails to mention how the molecular weight is controlled.

The examiner takes the position that it is known in the art that the molecular weight of a polymer is a cause effective variable to control the solubility of the polymer in a solvent. It would be expected that a polymer with a molecular weight that was too high to be difficult to solubilize or process into a thin coating layer in an electronic device.

A common means to control molecular weight in coupling reactions such as those taught by Lui is through the use of an end-capping agent which terminates the propagation of the polymer chain.

Yasuda discloses polyfluorene based polymers that are end-capped (abstract). Yasuda shows a polyfluorene polymer with end-capping groups represented by Formula Y-1 (page 5):



Yasuda teaches that bis(4-methylphenyl)(4-bromophenyl)amine (encircled) can be used as an end-capping group (paragraph 90).

The examiner notes that bis(4-methylphenyl)(4-bromophenyl)amine is a monobromotriphenylamine derivative which reads on the instant limitations.

In order to control the processablity of the fluorene based polymer, it would have been obvious to one of ordinary skill in the art at the time of the invention to have limited the molecular weight of copolymers of Lui/Chen which would have included using known end-capping agents such as bis(4-methylphenyl)(4-bromophenyl)amine as taught by Yasuda, absent unexpected results.

9. **Claim 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over Liu (Chemical Materials, Vol. 13, N0. 6, pages 1984-1991) in view of Chen (US 2004/0106003) and Inbasekaran (Syntheic Metals, 2000, pages 297-401)**

10. **Regarding Claim 15**, Lui and Chen teach the invention of claim1. Lui shows in scheme 1 (above) a fluorene monomer (compound 11) where the 9,9' alkyl groups on

the fluorenyl frame are n-hexyl groups. Lui fails to teach the 9,9' alkyl groups as octyl or ethylhexyl.

Inbasekaran discloses in polyfluorenes with a C-6 or higher substituents at the C-9 position are all soluble in conventional solvents and give strong emission. Inbasekaran gives examples which include a branched alkyl groups such as 2-ethylhexyl and straight chain alkyl groups such as n-hexyl and n-octyl (F8 bottom of page) (page 298).

The examiner notes that Lui also teaches the n-hexyl derivative.

The n-hexyl, n-octyl and 2-ethylhexyl alkyl groups are considered as functionally equivalent groups since Inbasekaran discloses that all of these derivatives give rise to polymers with strong emission.

It would have been obvious to one of ordinary skill in the art at the time of the invention to have exchanged the n-hexyl derivative for the n-octyl derivative or 2-ethylhexyl derivative (which reads on the instant limitations) at the C-9 position (applicants' R5 and R6) since Inbasekaran teaches that all these alkyl derivatives produce polymers with strong emission, absent unexpected results.

Response to Arguments/Amendments

Applicant argues that Chen fails to teach the dinapthylene derivative in a large molecule or polymer.

The examiner counters that although Chen does not mention the term polymer the luminescent efficiency properties ascribed to the dinapthylene would be also

produced in a polymer containing repeating units of said derivative. Additionally, one of ordinary skill in the art would readily recognize Chen's Formula C-2 (above) as a suitable monomeric species which fits the template of Br-Ar-Br (Compound 1-10 in scheme 1 above). The examiner maintains that Chen teaches clear advantages for incorporating a dinapthylene derivative into a material.

Applicant argues the Lui fails to mention a fluorenyl derivative bonded to a dinapthylene derivative and Chen fails to teach a dinapthylene derivative bonded to a fluorenyl derivative.

The examiner counters that the instant limitation is rejected with the combination of Lui and Chen not either separately. The examiner maintains that Lui teaches a template for a fluorene-Ar copolymer and Chen teaches a reactive dibromo-dinapthylene derivative with clear advantages which would have been attractive to one of ordinary skill in the art at the time of the invention.

One cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See In re Keller, 642 F.2d 413, 208 USPQ 871 (CCPA1981); In re Merck & Co., 800 F.2d 1091,231 USPQ 375 (FED. CIR. 1986).

Applicant argues that neither Lui nor Chen teach the x mol fraction or the y mol fraction and the x and y ranges are critical ranges that would not have been obvious to achieve through optimization.

The examiner counters that the unique properties binapthyl group was known in the art at the time of the invention. Chen discloses that the large dihedral angle between

the napthyl groups ensures a high degree of stereo-selectivity and results in non co-planer binapthyl unit (paragraph 9). The examiner views the large dihedral angle between the napthyl groups as equivalent to the applicants' "a polymer that has bends". Moreover, Chen discloses teaches that the binapthyl unit is responsible for high photo and electro-luminescent efficiency.

A skilled artisan would have adjusted the ratio of the x and y components to achieve an optimized luminescent efficiency. This process would have involved determine carrying out a series of Suzuki based polymerizations each with a different ratio components x and y. Each copolymer would be used in an organic layer between two electrodes and the resulting device would have been subjected to a voltage. The luminescence of each device would be measured to determine which ratio resulted in the most efficient luminescence which would have included the claimed ranges. As the prior art does not teach away from a specific range, applicants' claimed ranges would have been included in the optimization process.

The applicant's arguments with respect to the pending claims have been considered but are moot in view of the new grounds of rejection necessitated by the applicant's amendment.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP

§ 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to GREGORY CLARK whose telephone number is (571)270-7087. The examiner can normally be reached on M-Th 7:00 AM to 5 PM Alternating Fri 7:30 AM to 4 PM and Off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jennifer Chriss can be reached on (571) 272-7783. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should

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/Jennifer A Chriss/
Supervisory Patent Examiner, Art Unit 1786

GREGORY CLARK /GDC/
Examiner
Art Unit 1786